PATENT ABSTRACTS OF JAPAN

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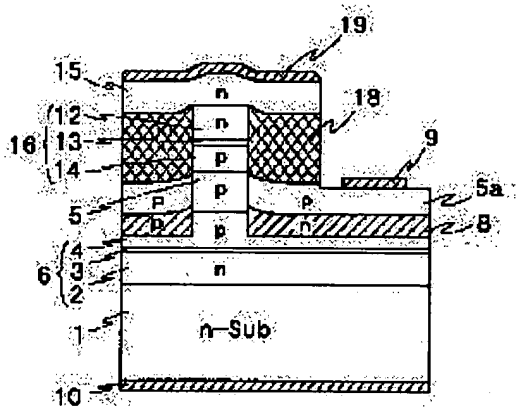
(54) SEMICONDUCTOR LASER AND ITS MANUFACTURE

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a semiconductor laser of a structure which is equipped with emission sources of laser beams of emission parts aligning in the direction perpendicular to the substrate, and obtained by a simple manufacturing process.

SOLUTION: This semiconductor layer is provided with a first light-emission part 6 formed of a semiconductor laminate part composed of an active layer 3 determined by a first emission wavelength and pinched by clad layers 2 and 4 which have each a larger band gap than the active layer 3, being formed on a semiconductor substrate 1. A second light emission part 16 formed of a semiconductor laminate part composed of an active layer 13 determined by a second emission wavelength and pinched by clad layers 12 and 14 which have each a larger band gap than the active layer 13, being formed on the first light emission part 6 through the intermediately of a contact layer 5. The first light emission part 6 and the second light emission part 16 are formed in line with each other in the normal direction of the semiconductor substrate 1.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the semiconductor laser oscillated in the wavelength region of the re system light used for DVD (digital videodisc), the reader of CD (compact disk), etc., or infrared light. In more detail light is emitted in at least two waves of light with one chip, and a production process is easy and it is related with the semiconductor laser of the structure which the beam of each wavelength moreover tends to use together with a substrate and a perpendicular direction.
[0002]
[Description of the Prior Art] In CD or DVD, the laser beam is used for the writing and read-out, and the light source the wavelength of 650nm band is used as 780nm band and an object for DVD as an object for CD, respectively. In order to consider as the equipment which reads this CD and DVD both, the laser light source which has two or more wavelength, such as for example, 780nm band and 650nm band, is demanded as that light source. Structure as such a semiconductor laser (henceforth LD) chip of one 2 waves of chip luminescence shown in JP,1-67992,A and shown i drawing 5 is known.
[0003] That is, the cap layer 35 which consists of n form cladding layer 32, a barrier layer 33, a p form cladding laye 34, and a p form GaAs is formed on the n form GaAs substrate 31, respectively, the 1st light-emitting part 36 is formed, the cap layer 41 which consists of n form cladding layer 38, a barrier layer 39, a p form cladding layer 40, an a p form GaAs with a different semiconductor material on the same substrate 31 of the width is formed, respectively and the 2nd light-emitting part 42 is formed. And each light-emitting part is formed in ridge structure, respectively, a the semiconductor laser which has the light-emitting part of two different wavelength on the same substrate is constituted by forming electrodes 43, 44, and 45 in the front face of the 1st and 2nd light-emitting parts 36 and 42, an the rear face of a substrate 31, respectively. However, with this structure, after carrying out the laminating of the sem conductor layer of the 1st light-emitting part 36 as shown also in this official report, selective growth of the semi-conductor layer of the 2nd light-emitting part 42 is carried out by carrying out etching removal of that part, and preparing the polycrystal film so that a semi-conductor layer may not deposit on the 1st light-emitting part 36.
[0004] As it is indicated by JP,7-263752,A and shown in drawing 6 on the other hand The laminating of the semi-conductor laminating sections 52, 53, and 54 which constitute each light-emitting part on the same semi-conductor substrate 51 is carried out one by one. The semi-conductor laminating section by which the laminating was carried o is etched stair-like, and the semi-conductor light emitting device of the structure of forming electrodes 55-58 in the lower layer exposed by the rear face of the semi-conductor substrate 51, the maximum top face of the semi-conducto layer by which the laminating was carried out, and ** etching, respectively is also proposed. In this structure, after etching a part of semi-conductor layer which carried out the laminating, a production process becomes easy at the po which does not need to grow alternatively, summarizes another semi-conductor layer, and can be etched.
[0005]
[Problem(s) to be Solved by the Invention] As mentioned above, the semiconductor laser which emits light in the lig of two or more wavelength with one chip accumulates the semi-conductor laminating section which arranges on the same substrate, and forms each light-emitting part, or constitutes each light-emitting part on the same substrate, and structure which etches stair-like is considered.
[0006] However, the former structure etches so that a semi-conductor substrate may be exposed after forming the 1st light-emitting part. While the laminating of the semi-conductor layer of the 2nd light-emitting part must be carried o so that a semi-conductor layer may not deposit on the 1st light-emitting part, and a production process is very complicated In order to grow up the semi-conductor layer of the 2nd light-emitting part so that the conditions of

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selective growth may be fulfilled, there is a problem that are hard to obtain a crystalline good semi-conductor layer, the outstanding luminescence property is hard to be acquired.

[0007] Moreover, when it is going to manufacture the semiconductor laser of the SAS structure which embeds ridge structure and a current constriction layer by the self aryne, the latter structure must sandwich an etching process for every light-emitting part, and has the problem that a production process becomes complicated similarly. Furthermore since the laser beam of each light-emitting part shifts not only in gap of x directions (refer to drawing 6) but in the direction of the z-axis when it constitutes semiconductor laser from structure shown in drawing 6 , there is a problem that the nest to equipments, such as relation with a condenser lens, becomes very complicated.

[0008] This invention aims at offering the semiconductor laser of the structure which can be acquired by the easy production process, and its process while it was made in order to solve such a problem, and the source of luminescen of the laser beam of each light-emitting part is equal to a substrate and a perpendicular direction.

[0009]

[Means for Solving the Problem] The 1st light-emitting part which consists of the semi-conductor laminating section which pinches the barrier layer which the semiconductor laser of this invention is prepared on a semi-conductor substrate and this semi-conductor substrate, and becomes settled on the 1st luminescence wavelength by the large cladding layer of a band gap from this barrier layer, It is prepared on the 1st light-emitting part, and has the 2nd light emitting part which consists of the semi-conductor laminating section which pinches the barrier layer which become settled on the 2nd luminescence wavelength by the large cladding layer of a band gap from this barrier layer. this -- Said the 1st light-emitting part and 2nd light-emitting part are formed so that it may stand in a line in the direction of normal of said semi-conductor substrate. In addition, the 3rd, the 4th -- The laminating of the light-emitting part can carried out further.

[0010] Since the 1st and 2nd light-emitting parts are located in a line with a lengthwise direction by making it this structure, etching removal of the semi-conductor layer which carried out the laminating once is carried out, it is not necessary to carry out selective growth of still more nearly another semi-conductor layer, and it can be manufactured very easily. And since the point of a laser beam emitting light is formed together with a semi-conductor substrate and perpendicular direction, it can make the beam of two or more wavelength condense with the same condenser lens, an can form compact and precise pickup.

[0011] Since etching of coincidence can constitute the ridge structure of the 1st and 2nd light-emitting parts while being able to demarcate a current impregnation field within the limits of predetermined and obtaining the semiconductor laser of a high property with a low threshold by forming said 1st and 2nd light-emitting parts in ridge structure, it can obtain very easily.

[0012] The 1st light-emitting part which has the cladding layer, barrier layer, and the 2nd electric conduction form cladding layer of the 1st electric conduction form established on the semi-conductor substrate of the 1st electric conduction form, and this semi-conductor substrate as concrete structure, this -- with the 2nd light-emitting part whic has the 1st contact layer of the 2nd electric conduction form established on the 1st light-emitting part, the 2nd electri conduction form cladding layer prepared on this 1st contact layer, a barrier layer, and the 1st electric conduction form cladding layer The crevice formed so that the 2nd electric conduction form cladding layer of said 1st light-emitting part, said 1st contact layer, and the semi-conductor layer that constitutes said 2nd light-emitting part may remain in t shape of a ridge, On [some] the 1st electrode formative layer of the 2nd electric conduction form embedded so that may connect with said 1st contact layer electrically through the 1st current blocking layer of the 1st electric conducti form into this crevice, and this 1st electrode formative layer And cover the ridge side face of said 2nd light-emitting part, and it is embedded. The 2nd current blocking layer which constitutes said 2nd electric conduction form claddin layer and barrier layer, and hetero barrier blocking of this 2nd light-emitting part is minded. It can constitute so that i may consist of the 2nd contact layer of the 1st electric conduction form which connects with the 1st electric conducti form semi-conductor layer of said 2nd light-emitting part electrically, and is established.

[0013] The semi-conductor laminating section from which the process of the semiconductor laser of this invention constitutes the 1st light-emitting part on (a) semi-conductor substrate, By etching until it carries out the laminating o the semi-conductor laminating section which constitutes the 1st contact layer and the 2nd light-emitting part one by o and results [from the front face of (b) this semi-conductor laminating section] in said 1st light-emitting part To the flank of the current impregnation field of the ridge configuration which makes a ridge configuration the current impregnation field of said 1st and 2nd light-emitting parts, and is formed of the (c) aforementioned etching The 1st current blocking layer which prevents a current with said 1st light-emitting part, the 1st electrode formative layer connected with said 1st contact layer, Selective growth of the 2nd current blocking layer which prevents a current wi said 2nd light-emitting part is carried out one by one. (d) The 2nd contact layer is formed on the semi-conductor

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laminating section which constitutes said 2nd light-emitting part, and the 2nd current blocking layer, and it is characterized by etching a part of said 2nd contact layer and 2nd current blocking layer so that a part of 1st electrode formative layer of (e) above may be exposed.

[0014] If it forms in the semi-conductor laminating section including the structure which pinches a barrier layer for s 2nd light-emitting part by both the cladding layers of n form and p form at least and forms in the flank of a barrier la [in / for said 2nd current blocking layer / said 2nd light-emitting part], and both cladding layers by the semi-conduc layer which constitutes hetero barrier blocking, a current blocking layer can be embedded easily. The combination of semi-conductor layer in which the difference of a band gap will be large and a current will not flow constituting hete barrier blocking here to the usual operating voltage is meant.

[0015]

[Embodiment of the Invention] Next, the semiconductor laser of this invention and its process are explained, referrin to a drawing.

[0016] The 1st light-emitting part 6 with which the semiconductor laser of this invention consists of the semi-conduc laminating section in which the cross-section explanatory view of the 1 operation gestalt pinches the barrier layer 3 which becomes settled on the 1st luminescence wavelength on the semi-conductor substrate 1 by the large cladding layers 2 and 4 of a band gap from the barrier layer 3 as shown in drawing 1 is formed. And the 2nd light-emitting pa 16 which consists of the semi-conductor laminating section which pinches the barrier layer 13 which becomes settled on the 2nd luminescence wavelength by the large cladding layers 12 and 14 of a band gap from the barrier layer 13 i formed through the 1st contact layer 5 on the 1st light-emitting part 6. And this the 1st light-emitting part 6 and 2nd light-emitting part 16 are formed so that it may stand in a line in the direction of a normal of the semi-conductor substrate 1 (lengthwise direction).

[0017] In the example shown in drawing 1 , the current blocking layer is formed in the crevice which the 1st and 2nd light-emitting parts 6 and 16 are formed in ridge structure, and forms the ridge. In this example, the 1st current blocking layer 8 of the 1st light-emitting part 6 is formed in the semi-conductor layer (pn junction of hard flow) of a different electric conduction form, and 1st electrode formative layer 5a which consists of GaAs of p form etc. so that may connect with the 1st contact layer 5 electrically on it is prepared. And in order that the 2nd current blocking laye 18 of the 2nd light-emitting part 16 may contact p form cladding layer 14 of the 2nd light-emitting part 16, a barrier layer 13, and n form cladding layer 12, hetero barrier blocking (HBB) structure is formed of the large semi-conducto layer of the band gap which constitutes the hetero barrier.

[0018] Thus, even when forming two waves of not components but three or more waves of components by forming each light-emitting part according to ridge structure, by carrying out the laminating of the semi-conductor layer for each light-emitting parts one by one, summarizing it, and performing etching for ridge formation, the ridge of each light-emitting part can be formed in coincidence, and a production process becomes easy very much. In addition, the current blocking layer of each upper light-emitting part is more desirable than the 2nd light-emitting part from the po that making it HBB structure using the semi-conductor layer which constitutes the hetero barrier like the current blocking layer in the 2nd above-mentioned light-emitting part simplifies a production process. Next, it explains in or of a production process according to an example, referring to the production process Fig. of drawing 2 -3.

[0019] First, as shown in drawing 2 (a), the n form GaAs substrate 1 is put in for example, in MOCVD (organic meta chemical vapor deposition) equipment. n form cladding layer 2 which consists of In0.49 (Ga1-zAlz) 0.51P (0.5<=z<=0.8, for example, z= 0.7) on a substrate 1 About 1.5-2 micrometers, The barrier layer 3 which consists of multiplex quantum well (MQW) structure by InGaP/In0.49 (Ga1-uAlu) 0.51P (0.3<=u<=0.7, for example, u= 0.4) made into the 1st luminescence wavelength of about 650nm on the whole For example, about 0.1 micrometers, Abou 1.5-2 micrometers grows p form cladding layer 4 which consists of In0.49 (Ga1-zAlz) 0.51P (0.5<=z<=0.8, for example, z= 0.7), the 1st light-emitting part 6 is formed and about 1-2 micrometers grows the 1st contact layer 5 whi consists of a p form GaAs further.

[0020] p form cladding layer 14 which consists of AlxGa1-xAs (0.4<=x<=0.7, for example, x= 0.6) succeedingly Furthermore, about 1.5-2 micrometers, The barrier layer 13 which consists of AlyGa1-yAs (0<=y<=0.2, for example y= 0.15) made into the 2nd luminescence wavelength of about 780nm For example, about 0.1 micrometers, About 0. 1 micrometer grows n form cladding layer 12 which consists of AlxGa1-xAs (0.4<=x<=0.7, for example, x= 0.6), respectively, and the 2nd light-emitting part 16 of double hetero structure is formed.

[0021] Next, mask ingredients, such as SiO2, are formed with a CVD method etc. all over a front face, and patternin carried out according to a photoresist process so that a mask 7 may be formed only in the part which forms a ridge-li light-emitting part. And as shown in drawing 2 (b), the part which exposes the semi-conductor layer by which the laminating was carried out using the sulfuric acid, the hydrogen-peroxide-solution solution, and the hydrochloric aci

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from a mask 7 by etching to the middle of p form cladding layer 4 in the 1st light-emitting part 6 is etched, and each light-emitting part becomes a ridge configuration. In addition, although not illustrated, in case the laminating of each above-mentioned semi-conductor layer is carried out, etching can be correctly stopped in the middle of p form cladd layer 4 by pinching about 0.05 micrometers of etching stop layers which consist for example, of a p form InGaP in th middle of p form cladding layer 4 in the 1st light-emitting part 6.

[0022] Then, a wafer is again put into semi-conductor growth equipments, such as an MOCVD system, with the mas 7 formed, and the 1st and 2nd current blocking layers 8 and 18 etc. are embedded in the crevice formed of etching in order to form a ridge, as shown in drawing 2 (c) (since only one chip is shown by a diagram, it is not a crevice, but since it is inserted by the ridge section of an adjoining chip, it is a crevice). In this case, by carrying out selective growth of the n form GaAs to the part which touches p form cladding layer 4 of the 1st light-emitting part 6, selectiv growth of the 1st electrode formative layer 5a which consists of a p form GaAs is carried out so that the 1st current blocking layer 8 which consists of pn junction of hard flow may be formed and the 1st contact layer 5 may be contac on it. Furthermore, the 2nd current blocking layer 18 which forms the hetero barrier constriction (HBB) structure wh consists of In0.49 (Ga1-vAlv) 0.51P (0<=v<=1) of a non dope so that the flank of p form cladding layer 14 of the 2n light-emitting part 16, a barrier layer 13, and n form cladding layer 12 may be embedded is embedded one by one.

[0023] Subsequently, a wafer is picked out from semi-conductor growth equipment, and the mask 7 which consists o SiO2 is exfoliated by fluoric acid etc. And a wafer is again put into an MOCVD system etc., and as shown in drawin (d), about 1 micrometer grows the 2nd contact layer 15 which consists of an n form GaAs.

[0024] Then, by preparing and carrying out patterning of the resist film to the whole front face, a mask 17 is formed, part of 2nd current blocking layer 18 which embeds the perimeter of the 2nd light-emitting part 16, and 2nd contact layer 15 are etched with the mixed solution of a sulfuric acid and hydrogen peroxide solution, and as shown in drawi 3 (e), a part of 1st electrode formative layer 5a electrically connected with the 1st contact layer 5 is exposed. And 1st electrode formative layer 5a exposed by the rear face of the semi-conductor substrate 1, and etching after removing a mask 17, And by forming electrodes 10, 9, and 19, respectively on the 2nd contact layer (the 2nd electrode formative layer) 15 prepared on the 2nd light-emitting part 16 The semiconductor laser of two-wave one chip with which the light-emitting part of two wavelength as shown in drawing 1 was located in a line in the direction of a normal of a semi-conductor substrate, namely, was located in a line with the lengthwise direction is obtained.

[0025] Although it was the example of two-wave one chip, the above-mentioned example can be easily formed by carrying out the laminating of the semi-conductor layer similarly, even when forming three or more waves of light-emitting parts in 1 chip. In this case, since a production process becomes easy by using hetero barrier blocking struct as mentioned above, the current blocking layer of the light-emitting part above the 1st light-emitting part is desirable

[0026] Since the light-emitting part of two or more wavelength is formed together with the lengthwise direction, whe according to this invention a laser beam is obtained together with a semi-conductor substrate and a perpendicular direction and uses for DVD, two or more beams with one condenser lens can be doubled, and since optical-axis adjustment is easy, it very becomes easy to use it. And since it is not necessary to carry out the laminating of the sem conductor layer for the 2nd light-emitting part and the laminating of all the semi-conductor layers can be continuous carried out after forming the semi-conductor laminating section which constitutes the 1st light-emitting part, and etching removes the part, a production process is very easy and it can obtain cheaply.

[0027] Moreover, since the laminating of the light-emitting part is carried out to length by forming the structure of demarcating the current impregnation field of each light-emitting part, according to ridge structure like the above-mentioned example, the ridge structure of each light-emitting part can be once formed in coincidence by etching. Therefore, a production process can be simplified further.

[0028] Furthermore, since the ridge structure of each light-emitting part is once formed by etching while the semiconductor laser of one chip which has two or more waves of light-emitting parts by the easy production process mentioned above is obtained according to the process of this invention, each light-emitting part can be aligned with a sufficient precision in a lengthwise direction. Consequently, it is cheap and quality semiconductor laser is obtained.

[0029] Although the semiconductor laser of one chip which has the light-emitting part of two or more wavelength by the easy production process as mentioned above by making it ridge structure is obtained, as shown, for example in drawing 4 , two or more waves of 1 chip semiconductor laser is obtained also with the SAS structure which embeds current constriction layer that it is easy to use by carrying out the laminating of the light-emitting part to a lengthwis direction.

[0030] In drawing 4 , the same sign is given to the same part as drawing 1 , and the explanation is omitted. p form cladding layer grows current constriction layer 8a which grows about 0.3 micrometers as 1st cladding layer 4a, and subsequently consists of n forms GaAs and InAlP at the n form GaAs substrate 1 top by n form cladding layer 2 and

barrier layer 3 carrying out a laminating to the above-mentioned example similarly, and it once takes out from semi-conductor growth equipment. And a mask is carried out with the resist film etc., stripe-like stripe slot 8b is formed b etching, about 1.5 micrometers grows p form 2nd cladding layer 4b with growth equipment again, and the 1st contac layer 5 is further grown up to be the same thickness by the same presentation as the above-mentioned example. The laminating of the semi-conductor layer for furthermore forming the 2nd light-emitting part 16 is carried out like the above-mentioned. The semiconductor laser of the vertical mold of SAS structure is obtained by embedding current constriction layer 18a by which stripe slot 18b was formed in one cladding layer (the example of drawing 4 n form cladding layer 12) also in this case.

[0031] In addition, since there is a level difference by stripe slot 8b of current constriction layer 8a in the 1st light-emitting part 6 when carrying out the laminating of the semi-conductor layer of the 2nd light-emitting part 16, in cas is growth of a barrier layer 13, membraneous quality tends to deteriorate. Therefore, it is desirable to carry out flattening as much as possible, and to form.

[0032] each above-mentioned example -- MOCVD -- although each semi-conductor layer was grown up by law -- th grown method of a semi-conductor layer -- MOCVD -- not only law but MBE (molecular beam epitaxy) -- other gro methods, such as law, may be used. Moreover, the laminated structure of the semi-conductor layer which forms a lig emitting part, and a barrier layer can be made into MQW structure, or making it bulk structure can be freely chosen according to a desired property. Moreover, the formation sequence of a light-emitting part is not limited to the above mentioned example, but can also form conversely the 1st above-mentioned light-emitting part and 2nd above-mentioned light-emitting part. In this case, when an InGaAlP system compound semiconductor constitutes a light-emitting part and it forms a current blocking layer according to HBB structure, an ingredient with a larger band gap than an InGaAlP system compound semiconductor, for example, InAlP etc., can constitute.

[0033]

[Effect of the Invention] Since the semiconductor laser which has two or more waves of light-emitting parts which aligned in the direction of a normal of a substrate on the substrate is obtained according to this invention, it can be us to the reader of both CD and DVD etc. very conveniently. Furthermore, since the ridge section of two or more light-emitting parts can be once formed by etching by forming, for example with ridge structure, it can manufacture by the very easy production process. Consequently, the semiconductor laser of two or more very cheap and highly efficient wave one chip is obtained.

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TECHNICAL FIELD

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PRIOR ART

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[0004] As it is indicated by JP,7-263752,A and shown in drawing 6 on the other hand The laminating of the semi-conductor laminating sections 52, 53, and 54 which constitute each light-emitting part on the same semi-conductor substrate 51 is carried out one by one. The semi-conductor laminating section by which the laminating was carried o is etched stair-like, and the semi-conductor light emitting device of the structure of forming electrodes 55-58 in the lower layer exposed by the rear face of the semi-conductor substrate 51, the maximum top face of the semi-conducto layer by which the laminating was carried out, and ** etching, respectively is also proposed. In this structure, after etching a part of semi-conductor layer which carried out the laminating, a production process becomes easy at the po which does not need to grow alternatively, summarizes another semi-conductor layer, and can be etched.

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EFFECT OF THE INVENTION

[Effect of the Invention] Since the semiconductor laser which has two or more waves of light-emitting parts which aligned in the direction of a normal of a substrate on the substrate is obtained according to this invention, it can be us to the reader of both CD and DVD etc. very conveniently. Furthermore, since the ridge section of two or more light-emitting parts can be once formed by etching by forming, for example with ridge structure, it can manufacture by the very easy production process. Consequently, the semiconductor laser of two or more very cheap and highly efficient wave one chip is obtained.

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MEANS

[Means for Solving the Problem] The 1st light-emitting part which consists of the semi-conductor laminating section which pinches the barrier layer which the semiconductor laser of this invention is prepared on a semi-conductor substrate and this semi-conductor substrate, and becomes settled on the 1st luminescence wavelength by the large cladding layer of a band gap from this barrier layer, It is prepared on the 1st light-emitting part, and has the 2nd light emitting part which consists of the semi-conductor laminating section which pinches the barrier layer which become settled on the 2nd luminescence wavelength by the large cladding layer of a band gap from this barrier layer. this -- Said the 1st light-emitting part and 2nd light-emitting part are formed so that it may stand in a line in the direction of normal of said semi-conductor substrate. In addition, the 3rd, the 4th -- The laminating of the light-emitting part can carried out further.

[0010] Since the 1st and 2nd light-emitting parts are located in a line with a lengthwise direction by making it this structure, etching removal of the semi-conductor layer which carried out the laminating once is carried out, it is not necessary to carry out selective growth of still more nearly another semi-conductor layer, and it can be manufactured very easily. And since the point of a laser beam emitting light is formed together with a semi-conductor substrate and perpendicular direction, it can make the beam of two or more wavelength condense with the same condenser lens, an can form compact and precise pickup.

[0011] Since etching of coincidence can constitute the ridge structure of the 1st and 2nd light-emitting parts while being able to demarcate a current impregnation field within the limits of predetermined and obtaining the semiconductor laser of a high property with a low threshold by forming said 1st and 2nd light-emitting parts in ridge structure, it can obtain very easily.

[0012] The 1st light-emitting part which has the cladding layer, barrier layer, and the 2nd electric conduction form cladding layer of the 1st electric conduction form established on the semi-conductor substrate of the 1st electric conduction form, and this semi-conductor substrate as concrete structure, this -- with the 2nd light-emitting part whic has the 1st contact layer of the 2nd electric conduction form established on the 1st light-emitting part, the 2nd electri conduction form cladding layer prepared on this 1st contact layer, a barrier layer, and the 1st electric conduction form cladding layer The crevice formed so that the 2nd electric conduction form cladding layer of said 1st light-emitting part, said 1st contact layer, and the semi-conductor layer that constitutes said 2nd light-emitting part may remain in t shape of a ridge, On [some] the 1st electrode formative layer of the 2nd electric conduction form embedded so that may connect with said 1st contact layer electrically through the 1st current blocking layer of the 1st electric conducti form into this crevice, and this 1st electrode formative layer And cover the ridge side face of said 2nd light-emitting part, and it is embedded. The 2nd current blocking layer which constitutes said 2nd electric conduction form claddin layer and barrier layer, and hetero barrier blocking of this 2nd light-emitting part is minded. It can constitute so that i may consist of the 2nd contact layer of the 1st electric conduction form which connects with the 1st electric conducti form semi-conductor layer of said 2nd light-emitting part electrically, and is established.

[0013] The semi-conductor laminating section from which the process of the semiconductor laser of this invention constitutes the 1st light-emitting part on (a) semi-conductor substrate, By etching until it carries out the laminating o the semi-conductor laminating section which constitutes the 1st contact layer and the 2nd light-emitting part one by o and results [from the front face of (b) this semi-conductor laminating section] in said 1st light-emitting part To the flank of the current impregnation field of the ridge configuration which makes a ridge configuration the current impregnation field of said 1st and 2nd light-emitting parts, and is formed of the (c) aforementioned etching The 1st current blocking layer which prevents a current with said 1st light-emitting part, the 1st electrode formative layer connected with said 1st contact layer, Selective growth of the 2nd current blocking layer which prevents a current wi said 2nd light-emitting part is carried out one by one. (d) The 2nd contact layer is formed on the semi-conductor

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laminating section which constitutes said 2nd light-emitting part, and the 2nd current blocking layer, and it is characterized by etching a part of said 2nd contact layer and 2nd current blocking layer so that a part of 1st electrode formative layer of (e) above may be exposed.

[0014] If it forms in the semi-conductor laminating section including the structure which pinches a barrier layer for s 2nd light-emitting part by both the cladding layers of n form and p form at least and forms in the flank of a barrier la [in / for said 2nd current blocking layer / said 2nd light-emitting part], and both cladding layers by the semi-conduc layer which constitutes hetero barrier blocking, a current blocking layer can be embedded easily. The combination of semi-conductor layer in which the difference of a band gap will be large and a current will not flow constituting hete barrier blocking here to the usual operating voltage is meant.

[0015]

[Embodiment of the Invention] Next, the semiconductor laser of this invention and its process are explained, referrin to a drawing.

[0016] The 1st light-emitting part 6 with which the semiconductor laser of this invention consists of the semi-conduc laminating section in which the cross-section explanatory view of the 1 operation gestalt pinches the barrier layer 3 which becomes settled on the 1st luminescence wavelength on the semi-conductor substrate 1 by the large cladding layers 2 and 4 of a band gap from the barrier layer 3 as shown in drawing 1 is formed. And the 2nd light-emitting pa 16 which consists of the semi-conductor laminating section which pinches the barrier layer 13 which becomes settled on the 2nd luminescence wavelength by the large cladding layers 12 and 14 of a band gap from the barrier layer 13 i formed through the 1st contact layer 5 on the 1st light-emitting part 6. And this the 1st light-emitting part 6 and 2nd light-emitting part 16 are formed so that it may stand in a line in the direction of a normal of the semi-conductor substrate 1 (lengthwise direction).

[0017] In the example shown in drawing 1 , the current blocking layer is formed in the crevice which the 1st and 2nd light-emitting parts 6 and 16 are formed in ridge structure, and forms the ridge. In this example, the 1st current blocking layer 8 of the 1st light-emitting part 6 is formed in the semi-conductor layer (pn junction of hard flow) of a different electric conduction form, and 1st electrode formative layer 5a which consists of GaAs of p form etc. so that may connect with the 1st contact layer 5 electrically on it is prepared. And in order that the 2nd current blocking laye 18 of the 2nd light-emitting part 16 may contact p form cladding layer 14 of the 2nd light-emitting part 16, a barrier layer 13, and n form cladding layer 12, hetero barrier blocking (HBB) structure is formed of the large semi-conducto layer of the band gap which constitutes the hetero barrier.

[0018] Thus, even when forming two waves of not components but three or more waves of components by forming each light-emitting part according to ridge structure, by carrying out the laminating of the semi-conductor layer for each light-emitting parts one by one, summarizing it, and performing etching for ridge formation, the ridge of each light-emitting part can be formed in coincidence, and a production process becomes easy very much. In addition, the current blocking layer of each upper light-emitting part is more desirable than the 2nd light-emitting part from the po that making it HBB structure using the semi-conductor layer which constitutes the hetero barrier like the current blocking layer in the 2nd above-mentioned light-emitting part simplifies a production process. Next, it explains in or of a production process according to an example, referring to the production process Fig. of drawing 2 -3.

[0019] First, as shown in drawing 2 (a), the n form GaAs substrate 1 is put in for example, in MOCVD (organic meta chemical vapor deposition) equipment. n form cladding layer 2 which consists of In0.49 (Ga1-zAlz) 0.51P (0.5<=z<=0.8, for example, z= 0.7) on a substrate 1 About 1.5-2 micrometers, The barrier layer 3 which consists of multiplex quantum well (MQW) structure by InGaP/In0.49 (Ga1-uAlu) 0.51P (0.3<=u<=0.7, for example, u= 0.4) made into the 1st luminescence wavelength of about 650nm on the whole For example, about 0.1 micrometers, Abou 1.5-2 micrometers grows p form cladding layer 4 which consists of In0.49 (Ga1-zAlz) 0.51P (0.5<=z<=0.8, for example, z= 0.7), the 1st light-emitting part 6 is formed and about 1-2 micrometers grows the 1st contact layer 5 whi consists of a p form GaAs further.

[0020] p form cladding layer 14 which consists of AlxGa1-xAs (0.4<=x<=0.7, for example, x= 0.6) succeedingly Furthermore, about 1.5-2 micrometers, The barrier layer 13 which consists of AlyGa1-yAs (0<=y<=0.2, for example y= 0.15) made into the 2nd luminescence wavelength of about 780nm For example, about 0.1 micrometers, About 0. 1 micrometer grows n form cladding layer 12 which consists of AlxGa1-xAs (0.4<=x<=0.7, for example, x= 0.6), respectively, and the 2nd light-emitting part 16 of double hetero structure is formed.

[0021] Next, mask ingredients, such as SiO2, are formed with a CVD method etc. all over a front face, and patternin carried out according to a photoresist process so that a mask 7 may be formed only in the part which forms a ridge-li light-emitting part. And as shown in drawing 2 (b), the part which exposes the semi-conductor layer by which the laminating was carried out using the sulfuric acid, the hydrogen-peroxide-solution solution, and the hydrochloric aci

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from a mask 7 by etching to the middle of p form cladding layer 4 in the 1st light-emitting part 6 is etched, and each light-emitting part becomes a ridge configuration. In addition, although not illustrated, in case the laminating of each above-mentioned semi-conductor layer is carried out, etching can be correctly stopped in the middle of p form cladd layer 4 by pinching about 0.05 micrometers of etching stop layers which consist for example, of a p form InGaP in th middle of p form cladding layer 4 in the 1st light-emitting part 6.

[0022] Then, a wafer is again put into semi-conductor growth equipments, such as an MOCVD system, with the mas 7 formed, and the 1st and 2nd current blocking layers 8 and 18 etc. are embedded in the crevice formed of etching in order to form a ridge, as shown in drawing 2 (c) (since only one chip is shown by a diagram, it is not a crevice, but since it is inserted by the ridge section of an adjoining chip, it is a crevice). In this case, by carrying out selective growth of the n form GaAs to the part which touches p form cladding layer 4 of the 1st light-emitting part 6, selectiv growth of the 1st electrode formative layer 5a which consists of a p form GaAs is carried out so that the 1st current blocking layer 8 which consists of pn junction of hard flow may be formed and the 1st contact layer 5 may be contac on it. Furthermore, the 2nd current blocking layer 18 which forms the hetero barrier constriction (HBB) structure wh consists of In0.49 (Ga1-vAlv) 0.51P (0<=v<=1) of a non dope so that the flank of p form cladding layer 14 of the 2n light-emitting part 16, a barrier layer 13, and n form cladding layer 12 may be embedded is embedded one by one.

[0023] Subsequently, a wafer is picked out from semi-conductor growth equipment, and the mask 7 which consists o SiO2 is exfoliated by fluoric acid etc. And a wafer is again put into an MOCVD system etc., and as shown in drawin (d), about 1 micrometer grows the 2nd contact layer 15 which consists of an n form GaAs.

[0024] Then, by preparing and carrying out patterning of the resist film to the whole front face, a mask 17 is formed, part of 2nd current blocking layer 18 which embeds the perimeter of the 2nd light-emitting part 16, and 2nd contact layer 15 are etched with the mixed solution of a sulfuric acid and hydrogen peroxide solution, and as shown in drawi 3 (e), a part of 1st electrode formative layer 5a electrically connected with the 1st contact layer 5 is exposed. And 1st electrode formative layer 5a exposed by the rear face of the semi-conductor substrate 1, and etching after removing a mask 17, And by forming electrodes 10, 9, and 19, respectively on the 2nd contact layer (the 2nd electrode formative layer) 15 prepared on the 2nd light-emitting part 16 The semiconductor laser of two-wave one chip with which the light-emitting part of two wavelength as shown in drawing 1 was located in a line in the direction of a normal of a semi-conductor substrate, namely, was located in a line with the lengthwise direction is obtained.

[0025] Although it was the example of two-wave one chip, the above-mentioned example can be easily formed by carrying out the laminating of the semi-conductor layer similarly, even when forming three or more waves of light-emitting parts in 1 chip. In this case, since a production process becomes easy by using hetero barrier blocking struct as mentioned above, the current blocking layer of the light-emitting part above the 1st light-emitting part is desirable

[0026] Since the light-emitting part of two or more wavelength is formed together with the lengthwise direction, whe according to this invention a laser beam is obtained together with a semi-conductor substrate and a perpendicular direction and uses for DVD, two or more beams with one condenser lens can be doubled, and since optical-axis adjustment is easy, it very becomes easy to use it. And since it is not necessary to carry out the laminating of the sem conductor layer for the 2nd light-emitting part and the laminating of all the semi-conductor layers can be continuous carried out after forming the semi-conductor laminating section which constitutes the 1st light-emitting part, and etching removes the part, a production process is very easy and it can obtain cheaply.

[0027] Moreover, since the laminating of the light-emitting part is carried out to length by forming the structure of demarcating the current impregnation field of each light-emitting part, according to ridge structure like the above-mentioned example, the ridge structure of each light-emitting part can be once formed in coincidence by etching. Therefore, a production process can be simplified further.

[0028] Furthermore, since the ridge structure of each light-emitting part is once formed by etching while the semiconductor laser of one chip which has two or more waves of light-emitting parts by the easy production process mentioned above is obtained according to the process of this invention, each light-emitting part can be aligned with a sufficient precision in a lengthwise direction. Consequently, it is cheap and quality semiconductor laser is obtained.

[0029] Although the semiconductor laser of one chip which has the light-emitting part of two or more wavelength by the easy production process as mentioned above by making it ridge structure is obtained, as shown, for example in drawing 4 , two or more waves of 1 chip semiconductor laser is obtained also with the SAS structure which embeds current constriction layer that it is easy to use by carrying out the laminating of the light-emitting part to a lengthwis direction.

[0030] In drawing 4 , the same sign is given to the same part as drawing 1 , and the explanation is omitted. p form cladding layer grows current constriction layer 8a which grows about 0.3 micrometers as 1st cladding layer 4a, and subsequently consists of n forms GaAs and InAlP at the n form GaAs substrate 1 top by n form cladding layer 2 and

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barrier layer 3 carrying out a laminating to the above-mentioned example similarly, and it once takes out from semi-conductor growth equipment. And a mask is carried out with the resist film etc., stripe-like stripe slot 8b is formed b etching, about 1.5 micrometers grows p form 2nd cladding layer 4b with growth equipment again, and the 1st contac layer 5 is further grown up to be the same thickness by the same presentation as the above-mentioned example. The laminating of the semi-conductor layer for furthermore forming the 2nd light-emitting part 16 is carried out like the above-mentioned. The semiconductor laser of the vertical mold of SAS structure is obtained by embedding current constriction layer 18a by which stripe slot 18b was formed in one cladding layer (the example of drawing 4 n form cladding layer 12) also in this case.

[0031] In addition, since there is a level difference by stripe slot 8b of current constriction layer 8a in the 1st light-emitting part 6 when carrying out the laminating of the semi-conductor layer of the 2nd light-emitting part 16, in cas is growth of a barrier layer 13, membraneous quality tends to deteriorate. Therefore, it is desirable to carry out flattening as much as possible, and to form.

[0032] each above-mentioned example -- MOCVD -- although each semi-conductor layer was grown up by law -- th grown method of a semi-conductor layer -- MOCVD -- not only law but MBE (molecular beam epitaxy) -- other gro methods, such as law, may be used. Moreover, the laminated structure of the semi-conductor layer which forms a lig emitting part, and a barrier layer can be made into MQW structure, or making it bulk structure can be freely chosen according to a desired property. Moreover, the formation sequence of a light-emitting part is not limited to the above mentioned example, but can also form conversely the 1st above-mentioned light-emitting part and 2nd above-mentioned light-emitting part. In this case, when an InGaAlP system compound semiconductor constitutes a light-emitting part and it forms a current blocking layer according to HBB structure, an ingredient with a larger band gap than an InGaAlP system compound semiconductor, for example, InAlP etc., can constitute.

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* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the cross-section explanatory view which is 1 operation gestalt of the semiconductor laser of this invention.
[Drawing 2] It is the cross-section explanatory view showing the production process of the semiconductor laser of drawing 1 .
[Drawing 3] It is the cross-section explanatory view showing the production process of the semiconductor laser of drawing 1 .
[Drawing 4] It is the cross-section explanatory view of other operation gestalten in the semiconductor laser of this invention.
[Drawing 5] It is the cross-section explanatory view of an example of the two-wave 1 chip semiconductor laser in th former.
[Drawing 6] It is the cross-section explanatory view of an example of the two-wave 1 chip semiconductor laser in th former.
[Description of Notations]
1 Semi-conductor Substrate
2 N Form Cladding Layer
3 Barrier Layer
4 P Form Cladding Layer
6 1st Light-emitting Part
12 N Form Cladding Layer
13 Barrier Layer
14 P Form Cladding Layer
16 2nd Light-emitting Part

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CLAIMS

[Claim(s)]
[Claim 1] The 1st light-emitting part which consists of the semi-conductor laminating section which pinches the barr layer which is prepared on a semi-conductor substrate and this semi-conductor substrate, and becomes settled on the luminescence wavelength by the large cladding layer of a band gap from this barrier layer, It is prepared on the 1st light-emitting part, and has the 2nd light-emitting part which consists of the semi-conductor laminating section whic pinches the barrier layer which becomes settled on the 2nd luminescence wavelength by the large cladding layer of a band gap from this barrier layer. this -- Semiconductor laser in which it is formed and which said the 1st light-emittin part and 2nd light-emitting part become so that it may stand in a line in the direction of a normal of said semi-conductor substrate.
[Claim 2] Semiconductor laser according to claim 1 which comes to form said 1st and 2nd light-emitting parts in rid structure.
[Claim 3] Semiconductor laser characterized by providing the following The semi-conductor substrate of the 1st electric conduction form The 1st light-emitting part which has the cladding layer, barrier layer, and the 2nd electric conduction form cladding layer of the 1st electric conduction form established on this semi-conductor substrate this the 1st contact layer of the 2nd electric conduction form established on the 1st light-emitting part The 2nd light-emitting part which has the 2nd electric conduction form cladding layer prepared on this 1st contact layer, a barrier layer, and the 1st electric conduction form cladding layer, The crevice formed so that the 2nd electric conduction for cladding layer of said 1st light-emitting part, said 1st contact layer, and the semi-conductor layer that constitutes said 2nd light-emitting part may remain in the shape of a ridge, On [some] the 1st electrode formative layer of the 2nd electric conduction form embedded so that it may connect with said 1st contact layer electrically through the 1st curr blocking layer of the 1st electric conduction form into this crevice, and this 1st electrode formative layer And cover t ridge side face of said 2nd light-emitting part, and it is embedded. The 2nd contact layer of the 1st electric conductio form which connects with the 1st electric conduction form cladding layer of said 2nd light-emitting part electrically, and is established through the 2nd current blocking layer which constitutes said 2nd electric conduction form claddin layer and barrier layer, and hetero barrier blocking of this 2nd light-emitting part
[Claim 4] (a) Carry out the laminating of the semi-conductor laminating section which constitutes the semi-conducto laminating section, the 1st contact layer, and the 2nd light-emitting part which constitute the 1st light-emitting part o semi-conductor substrate one by one. (b) by etching until it results [from the front face of this semi-conductor laminating section] in said 1st light-emitting part To the flank of the current impregnation field of the ridge configuration which makes a ridge configuration the current impregnation field of said 1st and 2nd light-emitting par and is formed of the (c) aforementioned etching The 1st current blocking layer which prevents a current with said 1s light-emitting part, the 1st electrode formative layer connected with said 1st contact layer, Selective growth of the 2n current blocking layer which prevents a current with said 2nd light-emitting part is carried out one by one. (d) The 2n contact layer is formed on the semi-conductor laminating section which constitutes said 2nd light-emitting part, and 2nd current blocking layer. (e) Process of the semiconductor laser characterized by etching a part of said 2nd contact layer and 2nd current blocking layer so that said a part of 1st electrode formative layer may be exposed.
[Claim 5] The process according to claim 4 which forms in the semi-conductor laminating section including the structure which pinches a barrier layer for said 2nd light-emitting part by both the cladding layers of n form and p fo at least, and is formed in the flank of a barrier layer [in / for said 2nd current blocking layer / said 2nd light-emitting part], and both cladding layers by the semi-conductor layer which constitutes hetero barrier blocking.

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